Amphibian Species Richness

Three EnviroAtlas national maps display the number of amphibian species based on potential habitat within each 12-digit hydrologic unit (HUC) in the conterminous United States. These data are based on habitat models rather than wildlife counts.

Southern Toad, M.A. Musselman, USFWS

Why are amphibian species important?

Amphibians are vertebrates in the Class Amphibia that includes frogs, toads, salamanders, newts, and caecilians (wormlike amphibians). Amphibian species are considered important biological indicators of the health of an ecosystem because they live in both aquatic and terrestrial environments. They are sensitive to environmental changes and pollutants partly because they absorb water and oxygen directly through their skin.

The metric, Amphibian Species Richness, estimates the number of amphibian species that may inhabit an area based on potential habitat. Species richness is frequently used as a surrogate for measuring biodiversity and as a measure of the relative conservation value of a particular area. Many scientists believe that biodiversity, because it represents all forms of life on earth, provides the core benefits that humans derive from their environment to sustain human society, economy, health, and well-being. Managing for biodiversity is one way to balance competing demands for various ecosystem services.[1]

Each species plays an important role within its ecosystem, and ecosystems are highly interconnected. The removal of even one species from an ecosystem can create a trophic cascade that can affect the entire food chain. Amphibians are secondary consumers in many food chains, acting as both predators and prey species. They eat large quantities of insects and help control pest populations that may damage plants and cultivated crops. Frog tadpoles feed on algae, which helps to keep waterbodies clean. Amphibians play important roles in ecosystem nutrient cycling and energy flow. Amphibians also contribute to human health by providing new pharmaceuticals. Frog secretions have been developed into treatments for pain and hypertension. Maintaining the diversity and richness of these species allows for the possible future discovery of more valuable human health treatments.

Many people enjoy viewing amphibian species and they seek them out in their natural habitats. Unfortunately, extreme declines in amphibian populations have been noted since the 1980s, with the extinction of at least 9 species. The Global Amphibian Assessment found that 42 percent of all amphibian species are in decline, and an additional 120 species have not been seen recently and are possibly extinct.[2] The reasons for these declines vary and often are not well understood, though habitat loss, pollution, invasive species, and diseases such as chytridiomycosis are established causes. The Southeast is the center of amphibian biodiversity in the U.S.; 91 amphibians are listed as species of concern with 19 species considered critically imperiled. The southern Appalachian Mountains and the Florida Panhandle have the highest concentrations of endangered amphibian species.[3]

How can I use this information?

Three EnviroAtlas maps, Mean, Maximum, and Normalized Index of Biodiversity (NIB), illustrate amphibian species richness for each 12-digit HUC in the conterminous United States.[4] Used together or independently, these maps can help identify areas of potentially low or high amphibian species richness to inform decisions about resource restoration, use, and conservation. Mean richness is a commonly used and understood value for comparison. NIB provides an index to compare a metric with other metrics across multiple project scales simultaneously. Maximum richness identifies habitats that are species rich but may not occupy large areas (e.g. linear riparian areas).

These maps can be used in conjunction with other EnviroAtlas maps such as ecoregions, the U.S. Geological Survey (USGS) protected areas database (PAD-US), or the USGS Gap Analysis Project (GAP) ecological systems to identify areas

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with high ecological or recreational value for conservation, recreation, or restoration planning. After learning the amphibian species richness values for a particular HUC, users can investigate an area more intensively by using individual species models available from the GAP Project.

How were the data for this map created?

The USGS GAP project maps the distribution of natural vegetation communities and potential habitat for individual terrestrial vertebrate species. These models use environmental variables (e.g., land cover, elevation, and distance to water) to predict habitat for each species. GAP modeled habitat for 282 amphibian species that reside, breed, or use the habitat within the conterminous U.S. for a significant portion of their life history.

Predicted habitat for the 282 amphibian species was combined to calculate amphibian species richness by pixel. The mean and maximum numbers of amphibian species in each 30-meter pixel were calculated for each 12-digit HUC. The mean species richness value by HUC was divided by the maximum mean value within all HUCs to calculate the NIB.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with these data. The data, based on models and large national geospatial databases, are estimations of reality that may overestimate actual amphibian presence. Modeled data are intended to complement rather than replace monitoring data. Habitat models do not predict the actual occurrence of species, but rather their potential occurrence based on their known associations with certain habitat types. Habitat is only one factor that determines the actual presence of a species. Other factors include habitat quality, predators, prey, competing species, and fine scale habitat features. Other essential species information in addition to species richness includes the types of species and their functional groups, whether they are rare or common, native or non-native, tolerant or intolerant of disturbance.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Individual 30-meter pixel data may be downloaded from the New Mexico State University Center for Applied Spatial Ecology.

Where can I get more information?

A selection of resources related to amphibians and biodiversity is listed below. Information on the models and data used in the USGS Core Science Analytics, Synthesis & Library's GAP project is available on their website. For additional information on how the data were created, access the metadata for the data layer from the layer list drop down menu. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgments

The amphibian species richness data were created through a collaborative effort between the EPA and USGS GAP. GAP habitat models were created by New Mexico State University, North Carolina State University, and Boise State University personnel. Kenneth Boykin and graduate students from New Mexico State University generated the biodiversity metrics. The fact sheet was written by Kenneth Boykin (New Mexico State University), William Kepner, Anne Neale, and Jessica Daniel (EPA), Sandra Bryce (Innovate!, Inc.), and Megan Culler (EPA Student Services Contractor).

Selected Publications

1. Boykin, K.G., W.G. Kepner, D.F. Bradford, R.K. Guy, D.A. Kopp, A. Leimer, E. Samson, F. East, A. Neale, and K. Gergely. 2013. A national approach for mapping and quantifying habitat-based biodiversity metrics across multiple spatial scales. *Ecological Indicators* 33:139–147.

2. International Union for Conservation of Nature (IUCN). 2019. The IUCN Amphibians Initiative: A record of the 2001–2008 amphibian assessment efforts for the IUCN Red List. IUCN in partnership with Conservation International and NatureServe. Accessed February 2020.

3. Wear, D.N., and J.G. Greis. 2002. Southern forest resource assessment: Summary of findings. *Journal of Forestry* 100(7):6–14.

4. Kepner, W.G., K.G. Boykin, D.F. Bradford, A.C. Neale, A.K. Leimer, and K.J. Gergely. 2013. Biodiversity Metrics Fact Sheet, EPA/600/F-11/006, U.S. Environmental Protection Agency, Washington, D.C.

Boykin, K.G., B.C. Thompson and S. Propeck-Gray. 2010. Accuracy of gap analysis habitat models in predicting physical features for wildlife-habitat associations in the southwest U.S. *Ecological Modelling* 221:2769–2775.